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FOREWORD

The Third Biennial Symposium on Turbulence in Liquids showed further progress in the investigator's ability to measure turbulence parameters and in the general understanding of turbulence. The most impressive advances in measurement seemed to be the ability to measure deeper into the turbulent boundary layer in order to obtain profiles over the entire turbulence production region and the rapid development of conditioned-sampling techniques for studying hypotheses for mechanisms.

Hot-wire and hot-film anemometry are still the predominant methods for measuring turbulence, but other methods, most notably laser-Doppler anemometry are under constant development. Laser-Doppler anemometry has, in fact, passed the stage of being tested for applicability and is producing turbulence data for systems where hot-film or -wire anemometry is not applicable or is difficult. This proceedings volume contains reports of nine investigations of turbulence using laser-Doppler anemometry. There was also another report of measurements near a wall with a split-film anemometer probe, which is showing possibilities of replacing the X-probe for measuring two components of turbulence especially near a boundary. Other methods under development are the electromagnetic and the airfoil (lateral-force) probes, each of which was reported in the symposium.

Applications of hot-film anemometry to difficult liquid systems are numerous. In this symposium there were reports of turbulence measurements with hot films in mercury, bubbly two-phase flow, a gas-solid stratified flow, flows with temperature gradients, and pulsating flow.

One session and considerable discussion were devoted to the advantages and problems of conditioned-sampling techniques for studying turbulence. Two of the invited lectures and three of the contributed papers (one listed under hot-film anemometry) dealt with this topic. It is from this area of investigation that the considerable advances in understanding the kinematics of turbulent fluid interactions in shear layers have come. As in any relatively new measurement technique, there is considerable disagreement among investigators on the correct methods and their interpretation. The dialogue between those using electronically modified signal sampling and those using the various methods of flow visualization has, however, produced a more detailed picture of shear turbulence than would have been imagined just ten years ago.

Research into the modification of turbulence phenomena by polymeric additives to produce viscoelastic solutions is continuing, as evidenced by the four papers in this symposium. All of these four efforts avoided probe techniques through use of laser-Doppler anemometry, visualization, or photographic techniques.

The panel discussion on promising directions for research in turbulence stressed the necessity to develop a proper philosophy of measurement, particularly where conditioned sampling is being used. Although there was some discussion of needed instrumentation, the feeling was that the hardware available mainly needs to be used imaginatively to make continued progress. The role of computing and modeling was discussed with differing viewpoints expressed by those who model and use computers for extensive signal conditioning and those who do physical experiments. The possibility of a moratorium on computer use was proposed with tongue-in-cheek. While there was some support for this position, it too was tongue-in-cheek as it was tempered with the knowledge that the computer is already indispensable.

The discussion brought out that on the practical side, turbulent phenomena are now being controlled and modified on many fronts. Much of this is as a result of basic research to gain understanding of the phenomena. It is on this basis that continued intensive research in turbulence in ultimately justified, and it seems that more detailed understanding is likely to result in just the next few years.

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Alexander Sesonske, Purdue University,
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Victor Goldschmidt, Purdue University
Promising Directions for Liquid Turbulence Research and Turbulence in Two-Phase Flow

J. W. Dunning, NASA-Lewis Research Center,
Laser-Doppler Anemometry

Val Kibens, University of Michigan,
Conditioned Signal Analysis

Virgil Sandborn, Colorado State University,
Hot-Film Anemometry

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